

From Painter & Wixom 1975  
Oroville Project Fish Investigation Program

Appendix I.

This section contains two parts:

- Part A. The agreement between the Department of Fish and Game and the Department of Water Resources concerning these investigations and Feather River Fisheries subjects.
- Part B. Correspondence concerning the panel of Fish Consultants that reviewed these investigations.

PART A. LOWER FEATHER RIVER - OROVILLE PROJECT FISH INVESTIGATION PROGRAM  
(Appendix 1 to Interagency Agreement No. 456705, page 94)

Need

Oroville Dam and its associated works will cause changes in the regimen of flows and quality of water in the Feather River. Various features of the project and certain aspects of the operation have been established during the planning stages of the project to maintain important fish populations at pre-project levels of abundance. Although there is no evident reason why the project and the flows agreed upon should be detrimental to fish life in the river, various factors which could be affected by the project will be investigated to determine in advance if changes in the operation are necessary to prevent serious losses.

Origin

The investigation is proposed with the anticipation that the Oroville Dam will be essentially completed in the fall of 1967 and changes in the downstream flow regime will commence at that time. Authority and suggested timing for this investigation are stated in Articles 29, 45, and 46 of Federal Power Commission Licensed Project No. 2100. These articles read as follows:

Article 29. The Licensee shall operate the project works in such a manner as to maintain in the main Feather River downstream from the proposed Thermalito Diversion Dam such flows as are determined by study and experimentation with the project in operation and as are mutually agreed upon by and as are acceptable to Licensee, the California Department of Fish and Game, and the Secretary of the Interior; Provided, that the flow in this reach shall not be less than 400 c.f.s. pending such determination and excepting any mutually agreeable modification for purposes of study and experimentation. In the event the parties named herein fail to reach an agreement as contemplated herein, the Commission reserves the right, after notice and opportunity for hearing, to make the determinations required under this article.

Article 45. The Licensee shall release into the Feather River from the Thermalito Afterbay discharge channel such minimum flows for the downstream fish populations as are determined necessary by study and experimentation with the project in operation and as are mutually agreed upon and acceptable to Licensee, California Department of Fish and Game, and the U. S. Fish and Wildlife Service. In the event the parties named herein fail to reach an agreement as contemplated herein, the Commission reserves the right, after an opportunity for hearing, to make the determinations required under this article.

Article 46. The Licensee shall prevent damage to fish and wildlife resulting from construction or operation of the project. Special precautions shall be taken to: (a) prevent discharge of silt, petroleum products, and other harmful substances or debris into the Feather River, (b) prevent loss, removal, disturbance, and compaction or shifting of gravel of the Feather River channel downstream from Thermalito Diversion Dam except as may be appropriate for protection or the improvement of fish habitat, and (c) prevent the project borrow areas from becoming sources of silt or other fines during floods or serving to dissipate stream maintenance flows or serving to trap anadromous fish.

It should be noted that the agreement between the Department of Fish and Game and the Department of Water Resources will restrict the magnitude of flows that could be released under Articles 29 and 45 of FPC License 2100.

## Objectives

The objectives of the study are to:

1. Determine if the project or its operation has resulted in an increase or decrease in fish life in the Feather River.
2. Study and measure periodically those environmental factors directly affected by the project which are capable of modifying fish production.
3. Recommend such measures as are necessary to compensate or mitigate for any losses that occur as a result of the project.

## Conditions of the Study

1. The study would begin July 1, 1967, and continue for eight years. In the event conditions occur such as exceptionally low water years, which temporarily delay attainment of the study objectives, the study could be extended by agreement between the two agencies.
2. A guiding committee would be established for the following purposes:
  - a. Maintain communication between the two agencies in matters regarding the study and coordinate the study-related activities of various units within each agency.
  - b. Review project reports and work plans to determine if progress is satisfactory and the study is proceeding properly according to the objectives.
  - c. Furnish technical consultation or assistance from the resources available to either agency.

The committee would consist of two representatives appointed by Water Resources and two by Fish and Game, together with such additional invited representatives of other agencies as the two departments may agree are necessary.

3. The study would be conducted by personnel of Fish and Game under contract to Water Resources. Water Resources would provide office space, equipment storage, services and equipment necessary for conduct of the study. Such services would include but not be limited to: secretarial assistance, aerial mapping or photography, measurement of flows and water quality parameters at various points on the Feather River, mechanical analysis of gravel samples, analysis of water samples, drafting, printing of reports.

Equipment would include, but not be limited to: boats, trailers, automotive vehicles, current meters, surveying equipment, nets. All such equipment would be retained by Water Resources after termination of need by the project.

4. Reports would be submitted to both Departments monthly, quarterly, and annually or at other intervals as may be determined by the advisory committee. A work plan and budget estimate would be submitted to Water Resources annually following approval by the advisory committee.

### Description of the Study

It is understood that the project and the flow release schedule agreed upon may be beneficial to some fish populations in the Feather River and be detrimental to others. The study will give primary attention to a determination of the effect on fall run king salmon because of the value of the resource and the more critical needs of this species during its life in the Feather River. However, an attempt will also be made to determine the effect of the project on other species.

#### 1. King Salmon - Fall Run

King salmon spawn in the Feather River downstream from the existing fish barrier dam and some will enter the hatchery being constructed at Oroville. The number of fish which spawn in the river has been estimated by a carcass recovery method for a number of years prior to the project. The number of salmon spawning in the river will be estimated each year during the study in essentially the same manner. The runs prior to the project will be compared by statistical methods to the run during the study period. The numbers of salmon will serve as a primary index of satisfactory maintenance of the run at the end of the study, although other factors affecting the total life cycle of the salmon will be taken into consideration during the course of that study.

The following tasks relating to king salmon would be included in the study:

##### a. Population Estimate

Salmon carcasses would be counted each fall during the period September 15 to December 31. Counts would be made and estimates of percentages recovery prepared on a weekly basis during this period. This operation would require one permanent man and two seasonal employees, two vehicles, a boat and outboard motor, and two boat trailers.

Counts of salmon entering the hatchery would routinely be counted by hatchery personnel.

##### b. Measurement of Salmon Spawning Gravel at Various Flows

It is assumed that the flow schedules agreed upon will provide adequate spawning conditions for maintenance of the salmon run. However, the basis for this assumption was a minimum study of the relationship between flows and gravel area in one section of the Feather River.

The area of suitable spawning gravel will be measured at various flows between 1,000 and 2,500 c.f.s. This information will be used to review the flows specified in the agreement for various conditions. We wish to verify that there is adequate gravel at the flows selected, and determine the minimum flow needed for incubation of the eggs under various conditions.

Observations of spawning salmon would be made to determine their distribution on the gravel in the river and to allow us to check the criteria used for selecting gravel suitable for salmon use.

The gravel area - flow relationship can be accomplished at any time the flows can be increased in step-wise fashion for a week at each flow interval. It is more difficult to use a decreasing series of flow intervals because of the water released from bank storage.

This task would require a general survey of the river to inspect and delineate the spawning gravel on aerial photographs. A number of representative riffles would be selected where it could be assumed that the measurements made on the selected riffles could reasonably apply to all spawning gravel in the river.

Actual measurement would require the establishment of reference stations at each representative riffle, aerial photographs at each flow, a crew of four to six men, two boats and motors, surveying instruments, two vehicles and boat trailers, and current meters.

Samples of gravel would be collected from the representative riffles for mechanical analysis.

The measurement of gravel should be done in 1968 and repeated once near the end of the study and in the event of significant channel changes by flood flows at any time during the study.

Mechanical analysis of the gravel would be repeated twice at 3-year intervals in connection with gravel quality studies.

c. Spawning Gravel Quality Study

Good spawning gravel for king salmon consists of clean gravel in the range of 1 - 6 inches in diameter with a minimum percentage of fines which would block the circulation of water through the gravel. Salmon eggs are deposited in a depression in the gravel which is formed by the female salmon. The eggs are then covered by gravel while the female forms a depression immediately upstream. The eggs may be covered at various depths from a few inches to 18 inches. They may incubate in the gravel up to two months depending on water temperatures. During this period water must circulate through the gravel to bring oxygen to the eggs and carry waste products away from the eggs; thus hatching success of the egg is related to gravel permeability. After the eggs hatch, the young salmon may remain in the gravel for up to two weeks while they utilize the food stored in their yolk sac. At the end of this period they must work their way up through the gravel until they are free in the stream.

Spawning gravel in the Feather River was generally considered to be in excellent condition prior to project construction. Although various measures were employed to reduce siltation of the river bed during construction, there is a strong possibility that gravel quality was reduced as a result of construction activities, particularly in the river adjacent to and below the borrow areas. If serious siltation occurred, it may not be removed by flushing flows during the first two or three years of project operation when the reservoir is filling.

Female salmon will not select gravel for spawning that contains too high a percentage of silt and fines. From previous work that has been done on other streams we can make a preliminary determination of suitability by performing a mechanical analysis of gravel samples from areas believed to be suitable for spawning. To complete this determination, observations must be made at the time salmon are spawning so that some correlation can be made between gravel permeability and the areas selected by salmon. If silt and fines are deposited on the gravel riffles after the deposition of eggs, the permeability of the gravel may be reduced to the extent that the eggs are smothered and die.

Extensive growths of algae can also cause a reduction in gravel permeability either because the algae mat prevents the passage of water in and out of the gravel, or because the algae tends to collect silt which would otherwise be transported downstream. Extensive algae growths usually die back at a time of the year when the conditions are less favorable. When this occurs the silt is left in place and it gradually works its way into the gravel. Flows high enough to dislodge the gravel can perform a cleaning action and carry away the excess silt or organic debris from the algae. In other streams below dams we have observed the increase in algae growth and silt deposition lead to a condition termed "cementing" of the gravel which makes the spawning gravel undesirable or unuseable for king salmon.

A study of gravel quality will be made on three occasions during the 8-year period. If significant channel changes occur in the stream it may be necessary to measure gravel quality an additional time. The measure of permeability will be made using standpipes inserted into the gravel in selected representative areas. The velocity of water in the gravel and its dissolved oxygen content will be measured at intervals throughout the spawning and egg incubation period. Samples of the gravel will be collected in the vicinity of the standpipes and a mechanical analysis performed on the samples. Eggs will be collected at intervals from the nests to measure hatching success.

This study would be conducted by the same crew which counts the salmon carcasses. It would require the use of specially constructed plastic standpipes, equipment for the determination of dissolved oxygen and pH, a conductivity bridge, and equipment for sampling gravel.

In the event a significant reduction of gravel permeability occurs, with a corresponding decrease in successful egg incubation, remedial measures will be recommended. The measures recommended would depend on the reasons for the decline of gravel quality but could include the occasional release of water to flush silt and fines from the gravel, mechanical renovation of selected areas, or separate action against waste dischargers in cooperation with the Regional Water Quality Control Board.

#### d. Egg Incubation Success

As described above, successful incubation of salmon eggs buried in the gravel depends on the continuous circulation of quality water around the eggs during their period of incubation. Hatching success may be seriously affected by fine materials in the gravel, the decay of organic materials entrapped in the gravel or its overlying silt and sand, the reduction of dissolved oxygen, an increase in CO<sub>2</sub> or hydrogen sulphide, or the addition of materials to the water which degrade water quality.

The measurement of hatching success would be made by collecting eggs from the salmon nests at intervals throughout their incubation period and noting the percentage of dead eggs. This would be done at representative spawning riffles throughout the portion of the Feather River which is utilized by salmon. A concurrent test will be made with eggs from the Oroville Hatchery in special containers buried in the gravel to determine the best method. The study would be conducted by the same personnel measuring gravel quality and would essentially be a part of the study.

d. Downstream Migration of Young King Salmon and Steelhead

King salmon in the Feather River will hatch during the January - March period of each year. Large numbers of these fish normally migrate downstream with the high flows which occur during the March - May period. We believe it is advantageous to have the salmon pass through the Delta and reach the ocean quickly during their first year of life. Some young salmon remain in the parent stream during their first year of life and migrate to the ocean the following winter or spring. Their growth is slower and they weigh less at maturity than the fish which reach the ocean quickly.

Tests made on the streams in Central Valley indicate a relationship between streamflow and downstream migration of young salmon. Releases from the project during the normal downstream migration period may be relatively steady and much lower than pre-project flows. The agreement specifies project conditions during which flows can be manipulated to determine necessity for such a procedure. Observations would be made on the downstream movement of young salmon during the first two years of project operation when flows should be relatively constant to determine if they migrate successfully at project flows and to determine if there are other critical factors affecting their movement. Movement is expected to be different during the initial years when deliveries of project water will not be made, so an attempt would be made to include years with and without water delivery. Studies would be conducted in two other years in which water conditions allow the manipulation of flows. If the need for flow manipulation can be demonstrated, a change in the project operation may be recommended prior to the termination of the study, otherwise observations will be made on the successful maintenance of the run during the study, and a final study of downstream migration made in the last year. The design of the study in that year will depend on whether or not the runs have decreased significantly and/or changes have been made in the project operations which could have a detrimental effect on the downstream migration of salmon.

This study would utilize the same personnel engaged in the study of gravel quality and egg incubation success in the years when those studies are conducted. In other years it would be conducted by the carcass recovery group.

In addition to vehicles and boats required for other studies, special nets or traps would be required. In some situations it may be more effective to use electrofishing equipment, which will also be used at various times during the year to sample resident fishes in the river.

## 2. King Salmon - Spring Run

The spring run king salmon generally migrate in the Feather River during April, May, and June, coincident with high spring runoff. In pre-project years they migrated to the areas in the Feather River upstream from the Oroville Dam site, in sections of the river where shelter and water temperatures were suitable until early fall. At that time they would seek out suitable gravel and spawn. It is believed they will spawn in late September or early October with the project. The remainder of their life history is the same as fall run king salmon.

Spring salmon migrating into the Feather River during 1967 will be forced to stop at the fish barrier dam. It is hoped that they will be able to live through the summer in pools immediately downstream from the barrier dam. If they live until fall, it is assumed a portion of the run will enter the hatchery to be spawned and the remainder will spawn satisfactorily in the Feather River somewhere downstream from the barrier dam.

The goal is to maintain the spring run king salmon in about the numbers estimated to have occupied the Feather River under pre-project conditions. The Feather River contains one of the few remaining spring run king salmon populations. It is desirable to maintain this run because of changes created in Central Valley streams by water developments. It is possible that their peculiar life history would be more adaptable to a particular water project operation than the fall run king salmon.

During the first three years of project operation, controlled flow conditions are expected to be different each year. In each of these three years the spring run salmon will be located and a method will be devised to estimate their numbers. If they attempt to enter the fish hatchery ladder, perhaps they will be marked and released back in the river. They will be observed at various times during the summer, and water quality conditions believed critical for their maintenance will be monitored. Observations also will be made of their spawning activity to determine if they have different requirements than the fall run salmon or utilize different areas of gravel. Their numbers will be estimated by the carcass recovery method used for fall run salmon and their spawning areas included in the gravel quality surveys for fall run king salmon.

After the first three years of observations it is assumed that the spring run salmon will be able to hold satisfactorily and their numbers can be estimated by carcass recovery method each fall. Or they will not hold satisfactorily and a decision would be made to allow this run to die out or devise special holding methods in connection with the Feather River Hatchery.

## 3. Striped Bass and Shad

Striped bass spawn in the lower Feather River and their young live a portion of their life between Gridley and Verona. It is assumed that post-project conditions would be satisfactory for striped bass but little is known of their numbers or life history in the Feather River. Although primary emphasis is given to the maintenance of salmon in scheduling flow releases from the



project, we do not wish to preclude the use of the Feather River by striped bass if it is within the project ability to maintain them. In order to understand what is happening to them, the study would include a period of observations during the normal spawning period, the trapping of adult striped bass to determine the exact time of spawning and the conditions required for successful spawning and tow-net surveys to determine the presence of eggs and newly hatched young.

Juvenile striped bass would be collected from the river at times when resident fishes are collected. It is proposed that observations on the striped bass would be collected during the first two years of project operation and the last two years of the study.

American shad spawn in the river during the May - June period each year. They have been observed primarily in the area between Oroville and the mouth of the Yuba River. It is possible they spawn farther downstream also. Their eggs are not buried in the gravel and they incubate within a few days. It is believed that the young shad migrate to the ocean almost immediately. It is possible that shad furnish more sport fishing in the river than any other anadromous species, although it is concentrated in a very short period.

As with striped bass, our knowledge of shad in the Feather River is not extensive. We assume that post-project conditions will be satisfactory for their continued maintenance in the river but observations will be made on them at the same time observations are made on the striped bass with the hope that we can determine whether or not there has been a significant change in their numbers by the end of the study period. The study will include the development of a method for estimating the size of the population during the spawning migration.

The study of both species will require special traps and nets which would be designed and constructed prior to their use in 1968. Four men and two boats would be required for this study but they could also work on other projects concurrently.

#### 4. Resident Fishes

The Feather River contains a variety of warmwater game fish and several kinds of undesirable fish. It is assumed that post-project conditions will be satisfactory for warmwater game fish but it is possible that conditions will be better for the undesirable fish such as carp, squawfish, and hardheads. It is doubtful that an increase in undesirable fish would cause a detectable decrease in game fish. It is possible that such an increase would have an adverse effect on the young migratory fishes because of increased predation. A preliminary study on the American River below Nimbus Hatchery indicates a predation of young salmon by resident fish in the American River may be a significant cause of loss. If predation of young salmon is believed to be serious on the Feather River and a decline in numbers returning to the spawning beds is found to occur, some corrective measure may be necessary. Samples of resident fish found in the Feather River at various locations will be collected during the first two years of project operation and in the last two years of the study. These samples will be expected to tell us the species composition of resident fish and if a significant number of

migratory fish remain in the river throughout the summer. Resident fish collected during the period of downstream migration for young salmon would be examined to determine if they are eating large numbers of the young salmon. This study would be conducted at intervals during the period March - October each year by the same personnel working with shad and striped bass.

Nets, traps, seines, and electrofishing gear used on other studies would also be used for this purpose.

5. Administrative Time and Equipment Maintenance

An undetermined amount of time would be required by permanent personnel each year for planning, report preparation, vacation and coordination of activities with other agencies. In addition, specific time would be allotted each year following major study programs for maintenance of nets, boats, and other special equipment. Time would also be reserved at the end of the study period for final report preparation.

6. Project Costs

An estimate of the annual and total cost of the project is attached. This estimate does not include provision of increases in salaries or employee benefits which may be granted by the Legislature during the period of study. It is assumed that the budget for the study will be modified as necessary in the event of raises in salaries or employee benefits. An amount has been added for contingency which is based upon the possibility of extending the study two years upon approval by the guiding committee described under Conditions of the Study No. 2 and agreement by the two departments.

## COST ESTIMATE FOR EIGHT-YEAR STUDY

	<u>1967-68</u>	<u>1968-69</u>	<u>1969-70</u>	<u>1970-71</u>	<u>1971-72</u>	<u>1972-73</u>	<u>1973-74</u>	<u>1974-75</u>
PERSONNEL								
Fishery Biol. III	10,872	10,872	10,872	10,872	10,872	10,872	10,872	10,872
Fishery Biol. II	8,952	8,952	8,952	8,952	8,952	8,952	8,952	8,952
Fishery Biol. II		1,492					1,492	
Seasonal Aid	27mm-11,205	24mm- 9,960	24mm- 9,960	18mm- 7,470	6mm- 2,484	12mm-4,968	39mm-16,146	14mm-5,796
Sub Total	31,029	31,276	29,784	27,294	22,308	24,792	37,462	25,620
Staff Ben. 11%*	3,413	3,440	3,276	3,002	2,456	2,727	4,120	2,818
Total Salaries	34,442	34,716	33,060	30,296	24,764	27,519	41,582	28,438
TRAVEL EXPENSE (at \$50/man/mo.)								
Seasonal Aids	1,350	1,200	1,200	900	300	600	1,950	700
FB III & II	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
FB II		100					100	
TOTAL SALARIES AND EXPENSE	36,992	37,216	35,460	32,396	26,264	29,319	44,832	30,338
ADMINISTRATIVE 13%	4,808	4,838	4,609	4,211	3,416	3,811	5,828	3,943
TOTAL	41,800	42,054	40,069	36,607	29,680	33,130	50,660	34,281

GRAND TOTAL \$308,281

 CONTINGENCY FUND 80,000  
 \$388,281

\*Retirement; OASDI; Health

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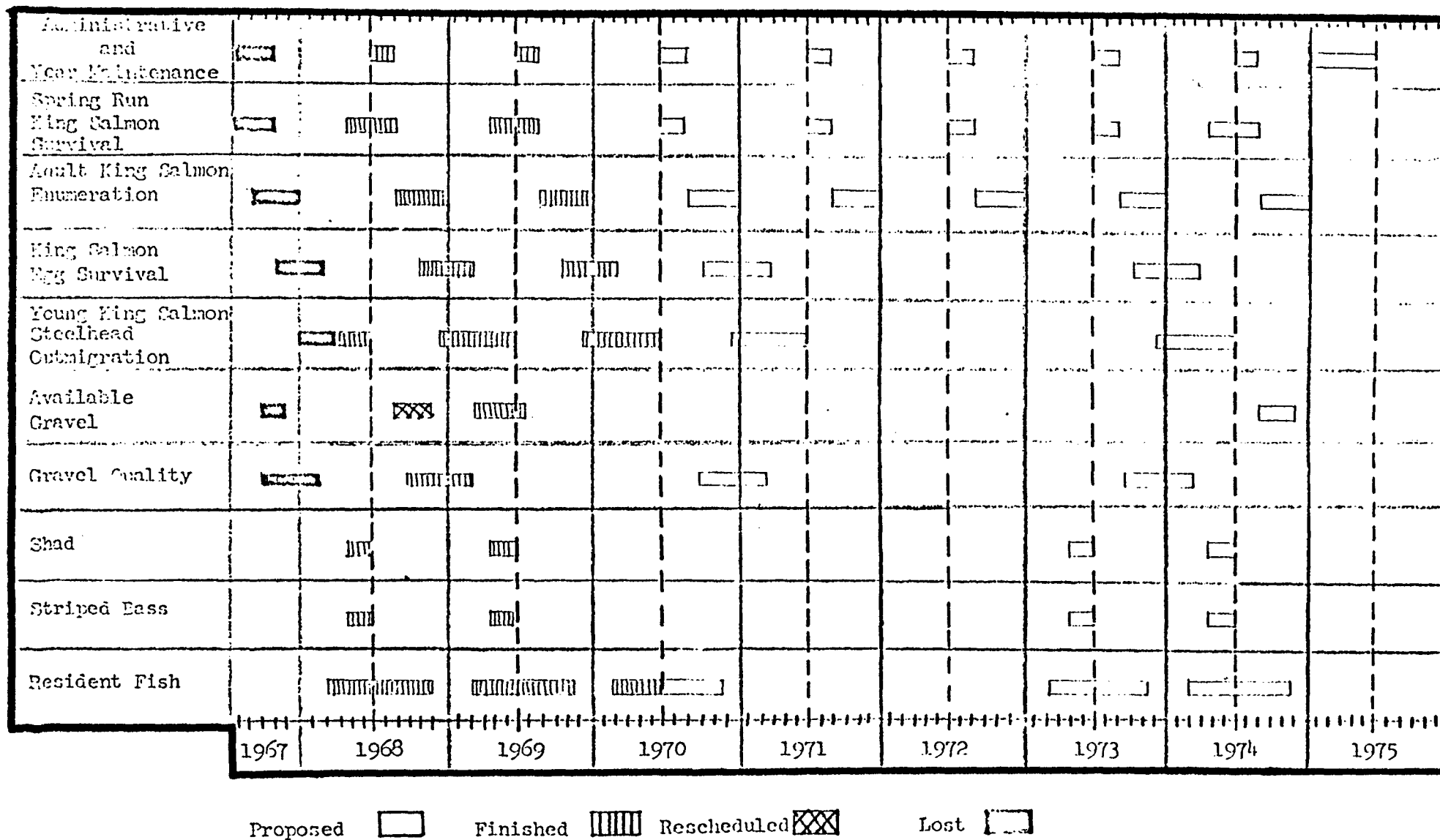




Figure 1. Lower Feather River Fishery Investigation Program Schedule, July 1967 to July 1975.

Proposed  Finished  Rescheduled  Lost 


















































































Administrative and Year Maintenance	1967	1968	1969	1970	1971	1972	1973	1974	1975
Spring Run King Salmon Survival									
Adult King Salmon Enumeration									
King Salmon Egg Survival									
Young King Salmon Steelhead Outmigration									
Available Gravel									
Gravel Quality									
Chad									
Striped Bass									
Resident Fish									

Figure 2. Lower Feather River Investigation Program Revised Schedule.

AGREEMENT AND STIPULATION

Concerning the Operation of the Oroville  
Division of the State Water Project

THIS AGREEMENT AND STIPULATION is made this 19th day of July, 1967, between the California Department of Water Resources (hereinafter referred to as "Water Resources") and the California Department of Fish and Game (hereinafter referred to as "Fish and Game") for maintenance of fish and wildlife in the Feather River below the Thermalito Diversion Dam and Thermalito Afterbay river outlet in compliance with Articles 29, 30, 43 and 45 of the License for Project 2100 (hereinafter referred to as License 2100) issued to Water Resources by the Federal Power Commission on February 11, 1957, and amended June 6, 1958, January 22, 1964, and April 15, 1966.

1. Water Resources shall release from the Thermalito Diversion Dam for fishery purposes a flow of not less than 400 cfs at all times, such flow is to be released into the Feather River and the Feather River Fish Hatchery pipeline. Any modification to this flow for purposes of study and experimentation is to be mutually agreeable to the parties hereto. Based upon the April through July unimpaired runoff of the Feather River near Oroville of the preceding water year (October 1 through September 30) additional water shall be released from the Thermalito Afterbay river outlet to maintain flows in the Feather River immediately below said outlet and to the mouth of the Feather River at Verona in accordance

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with the following schedule, provided that such additional releases would not cause Oroville reservoir to be drawn below elevation 733 feet (approximately 1,500,000 acre-feet):

The Preceding April through July Unimpaired Runoff* of the Feather River near Oroville, Percent of Normal**	Minimum Flow Schedule in Feather River Below Thermalito Afterbay		
	October through February	March	April through September
76% or greater	1,700 cfs	1,700 cfs	1,000 cfs
55-76%	1,700 cfs	1,700 cfs	1,000 cfs
Less than 55%	1,200 cfs	1,000 cfs	1,000 cfs

\*As computed for inclusion in Water Resources' Bulletin No. 120-xx "Water Conditions in California-Fall Report".

\*\*Normal is defined as the April through July 1911-1960 mean unimpaired runoff near Oroville, 1,942,000 acre-feet.

If the April 1 runoff forecast in a given water year indicates that, under normal operation of the project, the reservoir level will be drawn to elevation 733 feet (approximately 1,500,000 acre-feet), releases for fish life in the above schedule may suffer monthly deficiencies in the same proportion as the respective monthly deficiencies imposed upon deliveries of water for agricultural use from this project. However, in no case shall the fish water releases in the above schedule be reduced by more than 25 percent.

2. If for two or more consecutive water years the April through July unimpaired runoffs average less than 60 percent of normal, then the minimum flow shall be as shown for less than 55 percent in Paragraph 1.
3. In the event that during the period October 1 through November 15 of each year, the average flow within any one hour period of the combined project releases into the Feather River from the Thermalito Diversion Dam and the Thermalito Afterbay river outlet exceed 2,500 cfs, except in the event of flood control releases, accident, mechanical or electrical failure or outages due to major or unusual maintenance, the minimum flow in the Feather River specified in Paragraph 1 for the period October through March shall be modified in accordance with the following schedule:
  - (a) If the average flow within any one hour period exceeds 2,500 cfs but is less than 3,000 cfs, then the minimum flow specified in Paragraph 1 shall be 1,700 cfs October 1 through March 31;



- (b) If the average flow within any one hour period exceeds 3,000 cfs, but is less than 3,500 cfs, then the minimum flow specified in Paragraph 1 shall be 2,000 cfs October 1 through March 31;  
and
  - (c) If the average flow within any one hour period exceeds 3,500 cfs then the minimum flow specified in Paragraph 1 shall be 2,400 cfs October 1 through March 31, provided, however, the releases covered by this subparagraph c shall not be reduced by more than 500 cfs during any 24-hour period.
4. To facilitate downstream movement of juvenile salmon and steelhead in the April-June period, Fish and Game shall have the option of either or both:
- (a) Having a portion of or the total amount of water provided for minimum fish release from Thermalito Afterbay to the Feather River released in other than constant flows at mutually acceptable times and amounts.

- (b) Having water in excess of scheduled minimum fish flow releases made available ahead of time for release in a fluctuating pattern, if the April 1 Feather River runoff forecast and the projected operation of the project indicates that Oroville reservoir will spill or flood control releases will be made therefrom.

Exercise of the above options shall be on condition that there will be no interference with Water Resources' operation of the project for project purposes. Instantaneous minimum flow limitations stated in Paragraph 1 and flow fluctuation limitations stipulated in Paragraph 6 would not apply to fish flow release manipulations described in Paragraphs 4a and 4b.

- 5. The water supply for the Feather River Fish Hatchery shall be at the temperature shown in the following schedule. A deviation of plus or minus 4 degrees is allowable between April 1 through November 30.

<u>Period</u>	<u>Degrees Fahrenheit</u>
April 1 - May 15	51
May 16 - 31	55
June 1 - 15	56
June 16 - August 15	60
August 16 - 31	58
September 1 - 30	52
October 1 - November 30	51
December 1 - March 31	No greater than 55

It shall be an objective of Water Resources to provide water released below Thermalito Diversion Dam and Thermalito Afterbay river outlet, under schedules described in Paragraphs 1, 2 and 3 of temperature required to maintain downstream fish resources each year as follows:

- (a) Provision of suitable temperatures for fall-run salmon not later than September 15.
  - (b) Provision of suitable temperatures below Thermalito Afterbay river outlet for shad, striped bass, and other warm water fish between May 1 and September 1.
6. All flow releases in the river at the Thermalito Afterbay river outlet under 2,500 cfs shall not fluctuate more than 200 cfs during any 24-hour period, except in the event of flood control releases, accident, mechanical or

electrical failure or outages due to major or unusual maintenance. When it is mutually agreeable to the parties concerned, deviations from these conditions may be made.

7. The provisions of Paragraphs 1 through 5 shall become effective as soon as storage at Oroville reservoir is initially limited by flood control reservation requirements. Prior to that time the flow during the period November 16 to October 14 of the Feather River below Thermalito Afterbay shall be 800 cfs or, if less, the inflow to Oroville reservoir less diversion for Oroville-Wyandotte Irrigation District, Thermalito Irrigation District, and the Sutter Butte and Western Canals. For the initial October 15 to November 15 period following closure of Diversion Tunnel No. 1, the flow of the Feather River below Thermalito Afterbay shall be 1,000 cfs or, if less, the inflow to Oroville reservoir less the diversions specified above. For each October 15 to November 15 period thereafter until the storage in Oroville reservoir is initially limited by flood control reservation requirements the flow in the Feather River below Thermalito Afterbay shall be not less than 1,000 cfs.

Nothing in this Paragraph 7 shall be construed as authorizing flows of less than 400 cfs from the Thermalito Diversion Dam.

8. During the 8-year period following closure of Diversion Tunnel No. 1 Water Resources and Fish and Game will, by study and experimentation, assess the appropriateness of project operation in maintaining the preproject fish populations pursuant to Articles 29, 30, 43, and 45 of License 2100. However, in the event of the occurrence of year or years of less than 55 percent of April-July runoff, the study period will be extended an equal number of years. Funding of required studies and experimentation shall be the responsibility of Water Resources; provided, however, that the total amount of moneys expended for this purpose shall not exceed \$390,000. If at any time during the 8-year study there is a demonstrated net reduction in preproject fish populations attributable to project operations, mutually acceptable plans shall be developed by Fish and Game, Water Resources and the United States Fish and Wildlife Service to compensate for such reductions and to prevent further reductions. Said plans

shall be submitted to the Federal Power Commission for its approval. The plans will not include a change in the water flow maintenance schedule as shown in Paragraphs 1, 2 and 3 except in water years where the preceding April-July unimpaired runoff of the Feather River near Oroville is 76 percent or greater of normal. In the 76 percent or greater years increased releases may be made from the Thermaito Afterbay river outlet, if necessary, to increase the minimum flows specified in Paragraphs 1 and 3 up to 2,500 cfs during October 1 through March 31 period, provided the total increase for fishery purposes during this period does not exceed 100,000 acre-feet

The scope of the 8-year study shall be as contained in Appendix 1 to this Agreement and Stipulation, attached hereto and made a part hereof. In the event there is a net increase in pre-project fish populations as a result of operation of the project then such gains shall be recognized.

In the event the parties herein fail to reach an agreement as contemplated herein, any party may request the Commission to hold a hearing and make the determinations required under License 2100. Such request

shall not, however, propose any change in the water schedule shown in Paragraphs 1, 2 and 3, hereto, except within the limits agreed upon in this Paragraph 8.

9. The parties hereto agree that compliance with the terms of this Agreement and Stipulation by Water Resources shall constitute full compliance by Water Resources with the requirements of Articles 29, 30 and 45 of License 2100, and that neither Fish and Game nor Water Resources, except as provided in Paragraph 8 of this agreement or Article 43 of License 2100 shall request the United States Fish and Wildlife Service, the Secretary of Interior, the Federal Power Commission, or the State Water Rights Board to impose requirements on Water Resources other than the requirements set forth in this Agreement and Stipulation.

Any recommendation by Fish and Game, pursuant to Article 43 of License 2100, for the modification of presently authorized facilities or construction of new facilities, shall not propose any change in the water flow maintenance schedule previously agreed upon, or determined after hearing pursuant to Paragraph 8 herein.

10. Upon execution of this Agreement and Stipulation by the parties hereto, Water Resources shall:

- (a) File a copy of said Agreement and Stipulation with the State Water Rights Board requesting that the terms and conditions thereof over which the State Water Rights Board has jurisdiction be incorporated in any permit issued to Water Resources pursuant to Applications 5629, 5630, 14443, 14444, 14445A, 17512, 17514A, and 17515A.
- (b) File a copy of said Agreement and Stipulation with the Federal Power Commission requesting that it be approved as an exhibit to License 2100 and that the following article be added to License 2100:

"Compliance by licensee with the Agreement and Stipulation between licensee and the California Department of Fish and Game, Exhibit\_\_\_\_, shall constitute full compliance with Articles 29, 30 and 45 of this License."



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- (c) File copy of said Agreement and Stipulation with the Secretary of the Interior and the United States Fish and Wildlife Service requesting that they advise the Federal Power Commission that they approve said Agreement and Stipulation and the request made by Water Resources pursuant to subparagraph b of this Paragraph 10.

APPROVED AS TO LEGAL FORM  
AND SUFFICIENCY:

STATE OF CALIFORNIA  
DEPARTMENT OF WATER RESOURCES

/s/ Porter A. Towner  
Porter A. Towner, Chief Counsel  
Department of Water Resources

/s/ W. R. Gianelli  
Director

APPROVED AS TO LEGAL FORM  
AND SUFFICIENCY:  
Thomas C. Lynch, Attorney General  
Denis Smaage, Deputy Attorney General

STATE OF CALIFORNIA  
DEPARTMENT OF FISH AND GAME

By: /s/ Denis Smaage  
Attorneys for the  
Department of Fish and Game

/s/ Robert L. Jones  
For Director

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Appendix I

Part B. Correspondence concerning the Panel of Fish Consultants  
that reviewed these investigations (copies of originals).

December 30, 1969

Dr. Ernest Salo  
College of Fisheries  
University of Washington  
Seattle, Washington 98105

Dear Ernie:

Staff has informed me that the meeting December 10, 11 and 12 in Sacramento and Eureka of the Board of Fishery Consultants, State Water Project, was successful. Your Board provided many suggestions which were helpful to our programs.

At the conclusion of the meeting, Mr. David E. Belgen gave you a draft of several questions concerning the Feather River Fishery Investigation and promised some questions relating to the Eel River Fishery Studies that the Department would like the Board to respond to in writing. I am confirming these questions as follows:

A. Feather River Fishery Investigation

1. Is the Lower Feather River Fishery Investigation adequate to determine the effect of the Oroville Division features of the State Water Project on fisheries (spring-run and fall-run king salmon, steelhead, striped bass, shad and resident species)?
2. Is the investigation adequate to provide a basis for possible future modifications in project operations to permit increased protection or enhancement of fisheries?
3. Are each of the nine segments of the investigation receiving satisfactory attention or should there be any changes in priority or switch in emphasis among these segments?

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Dr. Ernest Salo

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B. Eel River Fisheries Studies

1. What studies would be needed to determine immediate, intermediate, and long-term effects imposed by possible projects upon Eel River downstream fish habitat?
2. Do you know of studies or examples that relate Pacific Northwest hatchery returns or success to the quantity, quality and velocity of the water into which anadromous fish are released? What water velocities are needed by salmon and steelhead of various sizes during downstream migration?
3. As indicated in our presentations to you on December 11 and 12, we consider landslides and related sediment problems to be a primary concern in planning for the protection and enhancement of Eel River fisheries. Do you feel that our emphasis on this matter is proper? Do you feel that we are working in the right direction to receive the problems?

- C. Do you have any additional general comments concerning any of the studies on which you were briefed during the three days?

I would appreciate a written response representing the consideration of all members of the Board on these questions as well as any comments or observations you might want to make.

I would hope to receive your response by the first of February. We have no firm plan as yet for the next meeting of the Board. Tentative thinking is to hold a meeting in the spring.

Sincerely yours,

Original signed by  
W. R. Gianelli  
Director

cc: Honorable G. Raymond Arnett  
Carl Werner  
Gordon Dukleth  
George McCammon

Same letter sent to: Mr. Milo C. Bell, Consultant  
Mr. Robert C. Meigs, Consultant

GEReiner:jah

Part B. (Continued)

MILO C. BELL  
Consulting Engineer  
Box 23  
Mukilteo, Washington 98275

May 27, 1970

Mr. William R. Gianelli  
Director  
Department of Water Resources  
P. O. Box 388  
Sacramento, California 95802

Dear Mr. Gianelli:

In response to the questions raised in your letter of December 30, 1969, we herewith are submitting our report covering the six questions asked in that letter, along with additional comments on the Eel and Feather rivers fishery investigations.

This report summarizes and, to some degree, extends the comments contained in our preliminary report of March 24, 1970. With that submission, certain exhibits and references were included. We understand that these have been circulated to those interested and, therefore, they are not included with this report. We request that such attachments be considered a part of the enclosed report.

Sincerely yours,

/s/ Milo C. Bell

Milo C. Bell  
Chairman, Board of  
Fisheries Consultants

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A. Feather River Investigation

1. Is the lower Feather River Fishery Investigation adequate to determine the effect of the Oroville Division features of the State Water Project on fisheries (spring-run and fall-run king salmon, steelhead, striped bass, shad and resident species)?

Answer 1. No, adequate emphasis has been given to some phases of the study, while other phases are either under- or over-emphasized.

2. Is the investigation adequate to provide a basis for possible future modifications in project operations to permit increased protection or enhancement of fisheries?

Answer 2. Generally, no, although some aspects of the study may be adequate. These are discussed below.

3. Are each of the nine segments of the investigation receiving satisfactory attention or should there be any changes in priority or switch in emphasis among these segments?

Answer 3. The emphasis on the nine segments is not satisfactory in that some receive greater attention at the expense of others. There should be some change in priority and emphasis.

The above answers are influenced by many factors, including the cost estimate for the eight year study.

Each of the nine segments, if properly conducted, can be a major research effort and the budget obviously is not adequate for this. An inadequacy is evident by the fact that one year already has been virtually lost; although the amount expended is not known to the consultants, the opportunity to obtain base line information is already lost.

This program is no different than most salmon investigations in which the initial base line information is not available to the investigators. In addition, the opportunity for the first year's indexing was lost as it was not until the 1969 investigations that project operations approached so-called normal or new base lines. The opportunity, then, to measure the old base line with a new base line is gone. We can only recommend that the situation as it now exists be accepted and measure the future changes.

1) Adult king salmon enumeration

It is recommended that the tagging of live adults be discontinued. Density counts (particularly if they can be supported by routine annual aerial surveys including photographs recording stream bed changes, riparian encroachment, and distribution of spawners) should be continued. Population estimates should be continued by the tagging of carcasses (references attached). An estimate should be made of the egg deposition and this should include an estimate of the

Feather River Investigations, continued:

eggs retained by the carcasses (references attached). The period of tagging and recovery will have to be accommodated to suitable stream levels.

2) Available gravel

Available gravel can be recorded by adequate ground mapping as a source of basic information, to be followed by aerial surveys, which would then be conducted annually during the estimated peak of spawning. Photographic records should be made at the time of aerial annual surveys-aerial photographs.

3) Gravel quality

There is no need for a continuing type of gravel quality study unless some special circumstances should arise. Egg and fry survival are the best indices of gravel quality, among other things. It would be well to reassess the quality of spawning gravel after severe floods and at timed intervals to note bottom changes brought about by silt and sedimentation, re-channeling, etc.

4) King salmon (and other species) egg survival

Annual egg and fry survival is most important and should be determined annually by a constant routine method of sampling. Egg pumps would be desirable for sampling (see attached reference). These studies should be expanded and carried on at a level that will insure statistically reliable data.

5) Downstream migrants

The downstream migration studies need not be elaborate, but should be coordinated with hatchery operations. All hatchery releases should be made at the hatchery site until at least such time as a surplus of adult fish is apparent and knowledge is gained as to number of smolts needed annually to guarantee a satisfactory level of returning adults. Mass marking techniques utilizing fluorescent pigment could be used to determine the contribution from natural spawning. Sampling of smolts in lower river would provide a ratio of marked to unmarked fish. Some type of permanent mark should be used on sample releases of hatchery smolts in order to evaluate hatchery contribution to number of returning adults. This should be done over a long enough period of time to establish efficiency levels of hatchery operation for greatest efficiency. From this point on, at least periodic releases of permanently marked fish should be made as a check against any deteriorating conditions, natural or operational.

Feather River Investigations, continued:

6) Spring-run salmon

If not held under ideal conditions, spring chinook will not survive until they are mature and capable of producing high quality eggs. The major number of adults should be held in the river channel until modifications to existing circular holding tanks prove them to be adequate (see attached references). Since successful holding is so essential, only sample-sized numbers should be held in circular pond until satisfactory conditions are achieved. Modifications may also be necessary to insure satisfactory river channel holding during periods when fish are present.

7, 8, and 9) Striped bass, shad and resident fish comments

The studies of resident fish, shad and striped bass for the present should be combined in a reasonably intensive creel census and should encompass all species caught routinely. This should not be on a random basis, but should be on a fixed time basis with a reasonable schedule that takes into account fluctuating water conditions. The creel census should include logging all information obtained that might be considered of basic importance should the need arise in the future for a more detailed study. With budgets critical, it is deemed of paramount importance at this time that efforts be concentrated on problems associated with king salmon.

Additional Comments

It is of great importance to upgrade the quality of water used at the hatchery. This might be done, possibly, by development of ground water or by trade for or purchase of better quality water such as is being done at present on a limited scale.

The results and success of the study of the effects of Oroville Dam on the Feather River will depend on a closely coordinated program with successful hatchery operation. The solution of the disease problems is most urgent, and the study of diseases at the hatchery and their abatement should be pursued intensely.

The management of the hatchery should be integrated into the research program, as production by the hatchery needs to be compared with stream production in order to assess the effects of the Oroville project.

The goal of the hatchery should be to produce an adequate number of fish that are actually in the smolting phase at the time of release, and the release time should coincide with the time wild smolts are leaving the river. The researchers

Feather River Investigations, continued:

should spell out exactly what the product should be and when it should be ready. The hatchery should have the responsibility of producing the product for planting at specified times.

It should be recognized that seldom is any hatchery an instant success. Problems at Oroville can be overcome as problems of a similar nature have been overcome elsewhere.

The number of fish entering the constant flow channel should be indexed.

It would appear that there is an opportunity to strengthen the numbers of steelhead using the Feather River by using hatchery production. It is recommended this be given consideration by research men to see what practical steps could be taken.

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MEMORANDUM

Honorable William R. Gianelli, Director  
Department of Water Resources  
1416 Ninth Street, Room 1115-1

Date: August 14, 1970

From: Department of Fish and Game

ES-State of California, Department of Water Resources - State Water Project - May 27, 1970 Report of the Board of Fishery Consultants

We have reviewed the latest report of the Board of Fishery Consultants for the State Water Project, which you sent us on June 5, 1970, and find that it provides some useful advice on the current fishery studies in the Eel River and lower Feather River. Our specific comments on the consultant's report are as follows:

Lower Feather River Fishery Investigation

In response to our general question on the adequacy of the investigation (Question No. 1), the consultants state that some phases of the study were being given undue emphasis, while other phases were not receiving proper attention. We agree with this conclusion, and have reoriented the program in accordance with most of their specific recommendations. This is discussed in more detail below.

The consultants also pointed out that each of the nine study phases, if properly conducted, would be a major research effort, and that the total eight-year budget is inadequate for such an effort. We also agree with this finding, which invites serious consideration of a modest budget augmentation to undertake the specific work recommended by the consultants. The work that needs additional funding is identified in subsequent discussions of each study phase. The comments and recommendations on each phase of the investigation, and the Department of Fish and Game's views thereon, are as follows:

1. Adult king salmon enumeration

The consultants recommended that the tagging of live adult salmon be discontinued and that population estimates be based on continued carcass tagging, bolstered with aerial surveys and photographs of spawning density and distribution, stream bed changes, and riparian vegetation encroachment. An estimate of egg deposition, including an estimate of eggs retained in carcasses was also deemed desirable.

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These recommendations are appropriate and we are following them to the extent permitted by available funds. Additional funding is required for the aerial photography work. An estimate of the annual cost of the aerial photographic work is being prepared.

2. Available Gravel

It is recommended that basic data on available gravel be collected by ground mapping, followed by annual aerial photographic records taken in connection with the work specified for item 1 above.

The basic gravel mapping is complete and we agree that aerial photos would provide an adequate check on gravel status. However, as mentioned above, supplemental funding would be needed for the photo work.

3. Gravel quality

The Board recommended discontinuing annual gravel quality studies, except after severe floods and at timed intervals to assess changes that might result from sedimentation and rechanneling.

This recommendation corresponds with the proposal made by my staff at the December 10 meeting with the consultants; therefore, we are in complete agreement.

4. King salmon egg survival

This study phase should be given more emphasis, according to the Board, by sampling annually with a uniform technique. Enough samples should be taken to insure statistically reliable data.

The Board's recommendation is in accordance with a proposal made by my staff at the December 10 briefing. Egg sampling is now scheduled for each year.

5. Downstream migrants

The Board offered several recommendations for downstream migrant king salmon sampling and evaluation of the Feather River Fish Hatchery, as follows:

- a. Sampling of wild juvenile fish should be coordinated with hatchery operations. All hatchery-reared salmon should be released at the hatchery site, until a conclusive determination is made of the quantity of juvenile fish required to produce a satisfactory level of adult returns.

- b. Hatchery effectiveness should be evaluated by permanently marking adequate samples of juvenile fish over a period of time sufficient to establish optimum hatchery efficiency.
- c. The contribution of natural salmon spawning should be measured by mass marking of wild smolts and subsequent sampling in the lower river to provide a ratio of marked to unmarked fish. Fluorescent pigment is cited as an effective mass marking technique.

The Board places emphasis on this study phase. We agree and believe it is the most important aspect of the salmon study. Out-migration measurement provides the best assessment of the river environment and the effects of Oroville Project operation, whereas returns of adult fish are influenced greatly by factors not associated with the Feather River.

Operation of the Feather River Hatchery is being coordinated with the downstream migrant study to greatest extent possible; however, it will not be feasible to fully implement the Board's suggestions for two reasons. First, the coldwater virus disease has reduced salmon production in the hatchery to such an extent that all available fish are being raised to yearling size before release. We are confident that the virus disease is now under control; however, it would not be wise to experiment with the hatchery fish until returns of adults to the hatchery have increased to design capacity. Also, if juvenile fish are released from the hatchery to coincide with the time wild smolts are migrating out of the river, mostly yolk-sac fry only would be available in the hatchery. Survival of yolk-sac fry would be low, based on previous experience.

Once adult returns to the hatchery reach a satisfactory level, we propose to evaluate hatchery effectiveness, using permanently marked fish. Hopefully, this work can be started without a long delay. It will be carried out as part of our statewide hatchery evaluation program.

We believe that marking and sampling of wild downstream migrant salmon must be expanded, as suggested by the consultants. Such work requires a budget augmentation, primarily for more temporary personnel.

#### 6. Spring-run salmon

The Board proposes that most of the spring-run salmon be held in the river, until holding facilities in the hatchery are completed and tested. They suggest that a relatively small number of spring-run fish be held in the circular holding tanks to determine their suitability for holding the entire run.

The population of spring-run salmon that is now successfully holding over the summer in the river is down to between 180 and 360 fish. We do not believe it would be wise to experiment at this population level until the hatchery disease problem is solved conclusively. When the population increases to about 600 fish, a test of hatchery holding capability would be appropriate.

7. American shad, striped bass, and resident fish

Replacement of all studies of striped bass, shad, and resident warmwater fish with a creel census was recommended by the consultants. They expressed the view that study efforts should be concentrated on king salmon, rather than other species, because of budget restrictions.

We agree that a creel census would provide useful data on the status of shad, resident fish, and striped bass populations and have commenced such a census. We disagree with their recommendation that other work on these species should be eliminated in deference to the salmon work. Our previously scheduled studies of these species will continue.

The creel census effort is, however, inadequately funded. A budget augmentation is justified in our view.

Additional comments

The Board presented several supplemental comments, as follows:

- a. Hatchery water quality and disease problems should be solved expeditiously.
- b. The number of fish entering the constant flow section of the Feather River should be indexed.
- c. Increased steelhead production should be considered for the hatchery.

We concur with these comments and are taking steps to implement them. The potential for steelhead fishery enhancement will receive attention when preservation of pre-project runs is assured.

In summary, the Board has identified a few areas in which study expansion is needed. Accordingly, additional funding is justified. My staff is preparing estimates of the costs of the expanded studies. We would appreciate an early meeting to consider the desirability of budget augmentation.

Eel River Fishery Investigation

The consultants' response to your specific questions on the Eel River fishery studies is prefaced with some data and comments on bed load sediment, turbidity, and landslides as related to fish production. Because of its general nature, this information is of moderate interest in our mutual efforts to understand and solve the difficult sediment problems associated with Eel River water development.

On page 2, the report states that reservoirs will reduce turbidity immediately downstream by storing sediment. We agree that peak turbidities would be substantially reduced; however, we are concerned about the probability of prolonged discharges of lower turbidity concentrations, which would be very detrimental to salmon and steelhead angling. We are aware that your Northern District water quality unit will be investigating this potential problem, in concert with our contract personnel assigned to that district.

The studies suggested by the Board in response to Question No. 1, especially those directed toward landslides and sediment, are appropriate and we urge that such studies be undertaken by your Northern District.

Special note was taken of two comments by the Board concerning landslides in the Eel River. On page 4, it is suggested that increased water releases might be the only solution to potential river blockage by landslides. We agree, but would like to emphasize that the project yield could be reduced by an unknown amount if stream closure occurred frequently.

We tend to disagree with the inference that reservoir inundation of landslides would improve water quality below the reservoir, as expressed in the fifth paragraph of the response to Question No. 1 on page 3. All proposed major reservoirs on the Eel River, including Yellow Jacket, have numerous slides downstream; consequently, large amounts of sediment would continue to enter the river.

The second paragraph of the answer to Question No. 2 may be misinterpreted in relation to the success of downstream salmon migration within impoundments. We do not know of any project in which adult fish have been transported above major storage dams for upstream spawning which has resulted in fully successful downstream migration of juvenile fish through a large reservoir. We do not propose such a measure in connection with any proposed North Coast export project because of failures in other states to maintain pre-project fish populations with this approach.

August 14, 1970

We concur with the additional biological and geological studies recommended by the Board in connection with Question No. 3. The biological studies can be carried out by our contract personnel in the Northern District; however, the scope and intensity of the studies must be restricted because funding through the Middle Fork Eel River Development program is limited.

The aerial photographic work recommended by the Board has already completed. After the 1964 and 1970 photographs are compared, the need for setting up photographic stations will be considered.

I appreciate the opportunity to review the consultants' report and offer comments. We look forward to working with your Department and the consultants on additional fishery opportunities and problems as they become evident.

/s/ L. H. Cloyd

For Director

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